Real-time positron emission tomography for range verification of particle radiotherapy

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Propositions

Belonging to the PhD thesis

Real-time Positron emission Tomography for Range Verification of Particle Radiotherapy

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1. *In vivo* range verification technique is an essential requirement to attain the inherent dosimetric superiority of particle radiotherapy.
2. PET-based provision of real-time feedback for triggering of intra-fraction treatment adaptation can only be obtained from imaging of beam-induced ^{12}N during particle therapy.
3. The short-lived positron emitter, ^{12}N, previously observed during irradiation with protons is also produced during irradiation with helium ions. Thus, real-time PET-based verification of helium radiotherapy is conceivable.
4. Beam delivery and scanner hardware optimization are required for sub-millimeter range measurement precision during proton and helium beam radiotherapy.
5. The performance of PET-based verification is better than prompt gamma detection during high intensity irradiations such as with synchrocyclotron and FLASH irradiations.
6. Clinical implementation of ^{12}N imaging requires the development of a framework for calculating predicted activity profiles. Providing data on the ^{12}N production cross-section vs energy is a non-trivial task.
7. On the path to true democracy, emerging democracies must foster critical thinking skills amongst her people.